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Subproject III: Fishery Enhancement in Large North Idaho Lakes

Study III: Enhancement of Kokanee in Priest and Pend Oreille Lakes

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JOB PERFORMANCE REPORT

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Title: Enhancement of Kokanee in Priest and Pend Oreille Lakes

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ABSTRACT

We used mid-water trawling techniques to assess the status of kokanee stocks in Pend Oreille, Priest, Spirit and Coeur d'Alene lakes. We measured abundance, monitored growth and estimated year class strengths.

Pend Oreille Lake supported 5.2 million kokanee in September 1983 as compared to 8.1 million in 1982. Less hatchery fry released, Incomplete sampling and earlier time of sampling were all contributing factors in estimating the smaller population size in 1983. An estimated 79,850 kokanee were spawned at the Granite Creek-Sullivan Springs weir, and 6,328,000 eggs were taken for hatchery rearing.

In Priest Lake the estimated kokanee population was 286,000 fish in September 1983. Hatchery fry planted in Granite Creek during the year had a survival rate of 27.5% compared to 5.4% for fry planted in mid-lake.

Spirit Lake supported 616,800 kokanee in July 1983, and densities still remained high at 1,076 kokanee per hectare. Fishing should improve as two larger year classes enter the fishery in 1984.

The mid-water trawl estimate of kokanee abundance in Coeur d'Alene Lake measured 6.48 million fish in August 1983. This value is approximately 3 million less than the 1982 estimate and is probably a result of the earlier timing of the sampling rather than an actual reduction in the numbers of kokanee in the lake.Total length at maturity continues to decline in Coeur d' Alene Lake.

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INTRODUCTION

The primary objectives of the kokanee investigations are to describe the status of kokanee populations in Idaho lakes and develop management prescriptions. Through a program of limnological studies, mid-water trawling, spawning escapement evaluation, age and growth analysis and angler harvest and opinions, we hope to gain more knowledge about kokanee population dynamics for development of alternatives to manage kokanee fisheries in Idaho lakes.

A comprehensive study of the kokanee population in Pend Oreille Lake was initiated in 1974, and the enhancement program for rebuilding the kokanee population began in 1975 with an introduction of 757,000 hatchery-reared fry. This program has continued through 1983 when 5.5 million fry were released in the lake and tributaries.

Kokanee investigations were initiated on Coeur d'Alene Lake in 1979. This population has been steadily increasing over the past few years resulting in reduced individual growth. In 1982 and 1983 chinook salmon were introduced in an attempt to control increasing kokanee numbers.

Kokanee population investigations on Spirit Lake were initiated In 1982 to relate the quality of the fishery to population size and composition. Hatchery introductions of kokanee fry were made on Priest Lake in 1982 and 1983 in an attempt to learn methods to revive the sagging populations.

OBJECTIVES

Evaluate the success of kokanee enhancement programs on major North Idaho lakes.

Develop and evaluate alternative stocking methods and locations for kokanee and make recommendations for future management.

TECHNIQUES USED

Kokanee Sampling

We made kokanee population estimates in Pend Oreille, Priest, Spirit and Coeur d'Alene lakes using mid-water trawl gear described by Bowler (1979, 1980a, 1980b). Sampling was accomplished with an 8.5 m cruiser equipped with a 140 hp diesel engine capable of pulling a 3x3 m mid-water trawl. The trawl net measured 13.7 m in length and contained mesh (stretch measure) graduated from 32, 25, 19 and 13 mm in the body to 6 mm in the coded. Trawl-caught kokanee were used for estimates of year class abundance, survival and potential egg deposition. Trawling exercises were conducted in September on Pend Oreille and Priest lakes, July on Spirit Lake and August on Coeur d'Alene.

Age and Length at Maturity

We collected total length and otolith samples from mature kokanee during the late fall spawning season. Spawners in Pend Oreille Lake were collected from the weir on Sullivan Springs and at Garfield and Scenic bays with gill nets. Gill nets were also used during the spawning run on Spirit Lake near the Christmas Tree Resort and in Wolf Lodge Bay on Coeur d'Alene Lake.

Hatchery Fry Introductions

We marked hatchery kokanee fry with tetracycline during 1983 prior to releasing them in Pend Oreille Lake, Priest Lake and tributaries of those lakes. Tetracycline (TM-50) was mixed with fish feed at the rate of 11% by weight (i.e., 1 kg TM-50 to 9 kg feed) per day for ten days prior to release.

All trawl-captured fry on Pend Oreille and Priest lakes were examined for tetracycline marks just after being hauled aboard the trawling boat. When marked fry are exposed to long-wave (3,600 A°) ultraviolet light in total darkness, a yellow sheen Is observed around the mandibles, opercles and bases of the pelvic and pectoral fins. The external mark is evident for several months after the fish are fed TM-50. When the external mark fades on older kokanee, the yellow sheen can be seen internally on the vertebrae. We were able to detect marked individuals from frozen specimens months after capture.

Tetracycline-marked fry have been released in Pend Oreille Lake or tributaries since 1978 (Table 1). The marked group of fry in 1983 was released approximately 1 km downstream of Cabinet Gorge Dam on the Clark Fork River.

Two plants of hatchery-reared kokanee were made in Priest Lake in 1983. One lot of 2,278,000 unmarked fry was released mid-water and the other group of 501,000 tetracycline-marked fry was released in Granite Creek.

We measured survival of hatchery-reared kokanee fry in 1983 by comparing estimates of tetracycline-marked fry in the lake during September to known numbers of marked fry released earlier in the year.

Sullivan Springs Weir

We have maintained a permanent weir station on the major kokanee spawning tributary to Pend Oreille Lake since 1974. This weir, located at the mouth of Sullivan Springs (tributary to Granite Creek), enables us to count kokanee entering Sullivan Springs and collect eggs for hatchery rearing.

Table 1. Location and composition of hatchery-reared kokanee fry re-leased in Pend Oreille Lake and tributaries.

Location	Date	Number of kokanee fry	Tetracycline marked
Sullivan Springs	7/79	1,745,730	Yes
Sullivan Springs	7/80	1,081,400	Yes
Sullivan Springs	7/81	2,219,800	Yes
Clark Fork River	7/81	1,933,600	Yes
Sullivan Springs	7/82	2,487,800	No
Clark Fork River	7/82	1,200,500	Yes
Clark Fork River	7/82	653,000	No
Scenic Bay	7/82	1,480,600	No
Pack River	7/82	21,300	No
Spring Creek	7/82	100,500	Yes
Gamblin Creek	7/82	8,400	No
Sand Creek	7/82	8,400	No
Strong Creek	7/82	8,400	No
Schweitzer Creek	7/82	8,400	No
Grouse Creek	7/82	7,700	No
East River	7/82	10,700	No
Hoodoo Creek	7/82	25,100	No
Priest River	7/82	22,500	No
Sullivan Springs	7/83	2,875,600	No
Clark Fork River	7/83	1,883,300	Yes
Clark Fork River	7/83	607,100	No
Strong Creek	7/83	12,000	No
Sand Creek	7/83	10,200	No
Schweitzer Creek	7/83	10,200	No
Pack River	7/83	25,500	No
Priest River	7/83	20,400	No
Grouse Creek	7/83	10,200	No
East River	8/83	20,400	No
Hoodoo Creek	7/83	25,400	No
Murphy Creek	8/83	17,000	No

FINDINGS

Pend Oreille Lake

Kokanee Population Estimates

From trawl data, we estimated Pend Oreille Lake supported 5.21 million (230/ha) kokanee in September 1983. Individual year class estimates included 2. 14 million of the 1982 year class, 2.28 million of the 1981 year class, 0.50 million of the 1980 year class and 0.29 million of the 1979-80 year classes. Comparative estimates for each year class from 1973 through 1982 are listed in Table 2.

Hatchery-Reared Fry Survival

We collected 239 fry in the September trawl, of which six were tetracycline marked. Releases of 1,883,300 marked fry into the Clark Fork River were made in July, and from that we estimated that 60,500 marked fry resided in the lake In September. The survival rate of 3.2% from release to September is compared to estimates of 32.8% in 1982.

Spawning Escapement and Age at Maturity in Sullivan Springs

An estimated total of 79,850 kokanee were captured in the trap and spawned, yielding 6,328,000 eggs for rearing to fry for release in the summer of 1984 (Table 3). The total estimate of kokanee using Granite Creek and Sullivan Springs was 100,000 fish. The projected spawning run, based on tetracycline-marked mature kokanee collected in the September trawling was 141,657. Straying of marked fish was again evident in 1983 by the capture of tetracycline-marked spawners in other areas of the lake (Table 4). More than 70% of spawners captured at sites other than Granite Creek were tetracycline marked.

Age composition of Granite Creek and Sullivan Springs spawners in 1983 was 58% 3+ kokanee (1979 year class) and 42% 4+ kokanee (1978 year class) (Fig. 1).

Length at Maturity

We have monitored kokanee spawner lengths In Pend Oreille Lake since 1951, and mean lengths have varied from a high of 292 mm in 1951 to a low of 245 mm in 1976 (Fig. 2). With the 1983 mean total length of 272 mm, the trend continues to show an increase since 1976.

Table 2. Mid-water trawl estimates of the 1973—82 kokanee year-classes made in Pend Oreille Lake, Idaho, during 1977-83. Estimates are millions of kokanee.

	Year estimated						
Year-class	1983	1982	1981	1980	1979	1978	1977
1982	2.14						
1981	2.28	3.84					
1980	0.50	2.77	2.31				
1979	0.29	0.64	1.36	1.69			
1978		0.87	0.79	1.00	2.01		
1977			0.74	0.96	1.31	1.82	
1976				1.03	1.70	0.71	2.01
1975					0.67	2.00	1.17
1974						1.29	2.95
1973							0.65
Total	5.21	8.12	5.20	4.68	5.69	5.82	6.78

Table 3. Weir counts of kokanee entering Sullivan Springs from 1974 through 1983, the number of eggs collected and subsequent fry released into Sullivan Springs.

Year	Kokanee spawned	Eggs collected	Fry released following year[a]	Estimated returning adults from hatchery releases and year returned		% hatchery fry returning as adults
1974	13,549	985,000	629,200	NA		NA
1975	14,200	NA	NA	NA		NA
1976	10,200	913,000	757,700	55,500 42,200	(1980) (1981)	12.96%[b]
1977	17,560	2,040,000	1,598,800	135,300 29,000	(1981) (1982)	10.28%[b]
1978	16,875	1,400,000	1,745,700	118,000 58,000	(1982) (1983)	10.08%
1979	12,005	1,451,400	1,081,400	42,000	(1983)	
1980	48,760	4,186,700	2,219,800			
1981	112,820	11,653,000	2,487,800			
1982	115,850	11,432,900	2,875,589			
1983	79,850	6,320,000				

[a]Additional fry were released in other areas.
[b]This number reflects only those tetracycline-marked adults entering Sullivan Springs. Unknown numbers of marked adults have been documented spawning with wild kokanee in the Bayview area.

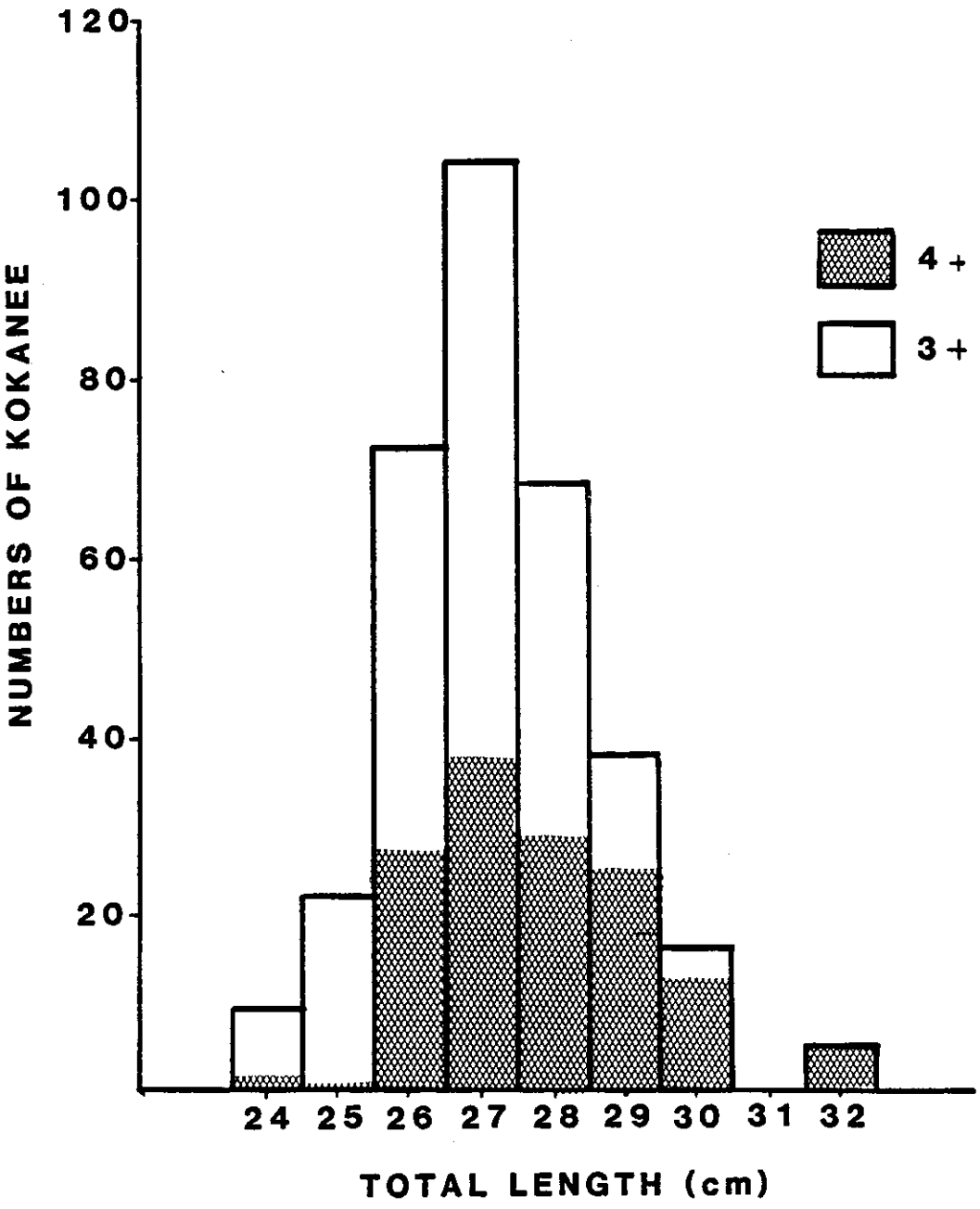

Figure 1. Length frequency of 1973 and 1979 year class kokanee spawners collected from Sullivan Springs (tributary to Granite Creek), Pend Oreille Lake, Idaho, in November-December, 1933.

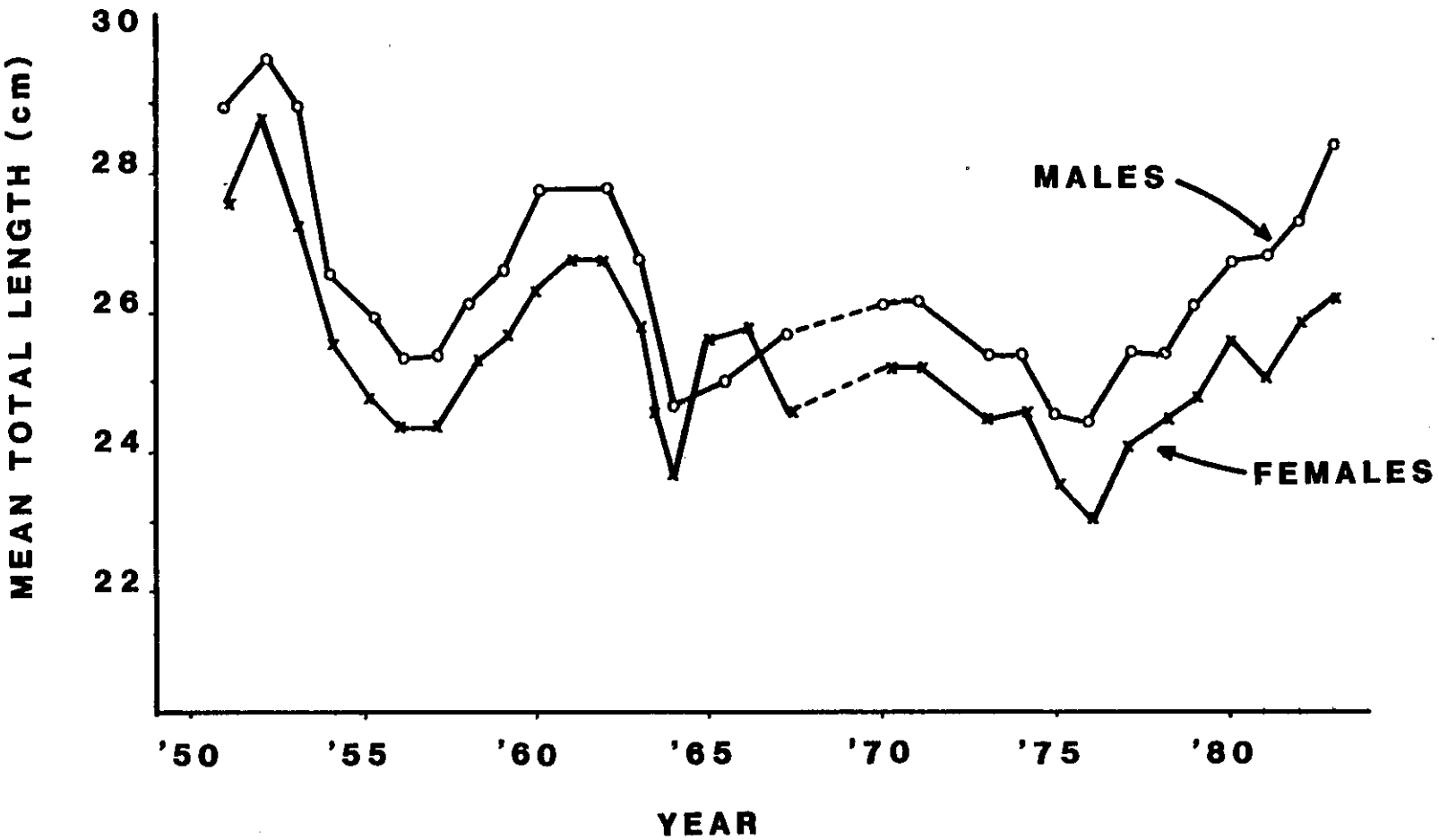

Figure 2. Mean total length of kokanee spawners measured in Pend Oreille Lake, Idaho, 1951-83.

Priest Lake

Kokanee Population Estimates

We estimated Priest Lake supported 286,200 kokanee in September 1983. Age class 0+ fry numbered 261,900 and age class 1+ fish totaled 24,300. Tetracycline-marked fry represented 48% of the trawl catch or 137,800 of the estimated population. All age class 1+ kokanee had tetracycline markings.

Kokanee fry planted in mid-lake had an estimated 5.4% survival rate compared to 27.5% for fry planted in Granite Creek.

Spirlt Lake

Kokanee Population Estimates

The estimated kokanee population was 616,800 fish (1,076/ha) in July 1983. Individual year class estimates were 143,300 for the 1982 cohort, 272,600 for the 1981 year class, 146,800 for the 1980 year class and 54,200 for the 1979 and 1978 cohorts. Comparative year class strengths are given in Table 5.

Age and Length at Maturity

We examined otoliths from 92 kokanee spawners during November 1983. Age 3+ kokanee comprised 73% of the spawning population and 4+ fish, 27% of the spawners (Fig. 3).

Potential Egg Deposition and Fry Survival

We made an estimate of potential kokanee spawning escapement in Spirit Lake by determining the number of mature fish collected in the July trawling and subtracting the estimated creel (5,000 mature kokanee) between trawling and spawning. The estimated escapement was 61,400 kokanee. Using a 1:1.2 male to female ratio and a fecundity of 545 eggs per female, the potential egg deposition is estimated at 18,252,400.

We estimated a potential kokanee egg deposition of 15,400,000 in 1982 and a wild fry population of 143,300 fish, which yields a 0.9% survival rate (Table 6).

Table 4. Number of tetracycline-marked spawners sampled in Pend Oreille Lake and tributaries, November-December, 1983.

Location	Sample gear	Number of fish	Number marked	Percent marked
Bayview	gillnet	49	46	94
Gamblin Creek	dipnet	11	1	9
Garfield Bay	gillnet	33	26	79
Spring Creek	dipnet	13	3	23
Sullivan Springs	dipnet	341	330	97

Table 5. Mid-water trawl estimates of the 1977-82 kokanee year-classes made in Spirit Lake, Idaho, during 1981-83. Estimates are in thousands of kokanee.

Kokanee year-class	Year estimated		
	1983	1982	1981
1982	143.3		
1981	272.6	526.0	
1980	146.8	209.0	281.3
1979	54.2	57.7	73.4
1978		48.0	82.1
1977			92.6
Total	616.9	840.7	529.4

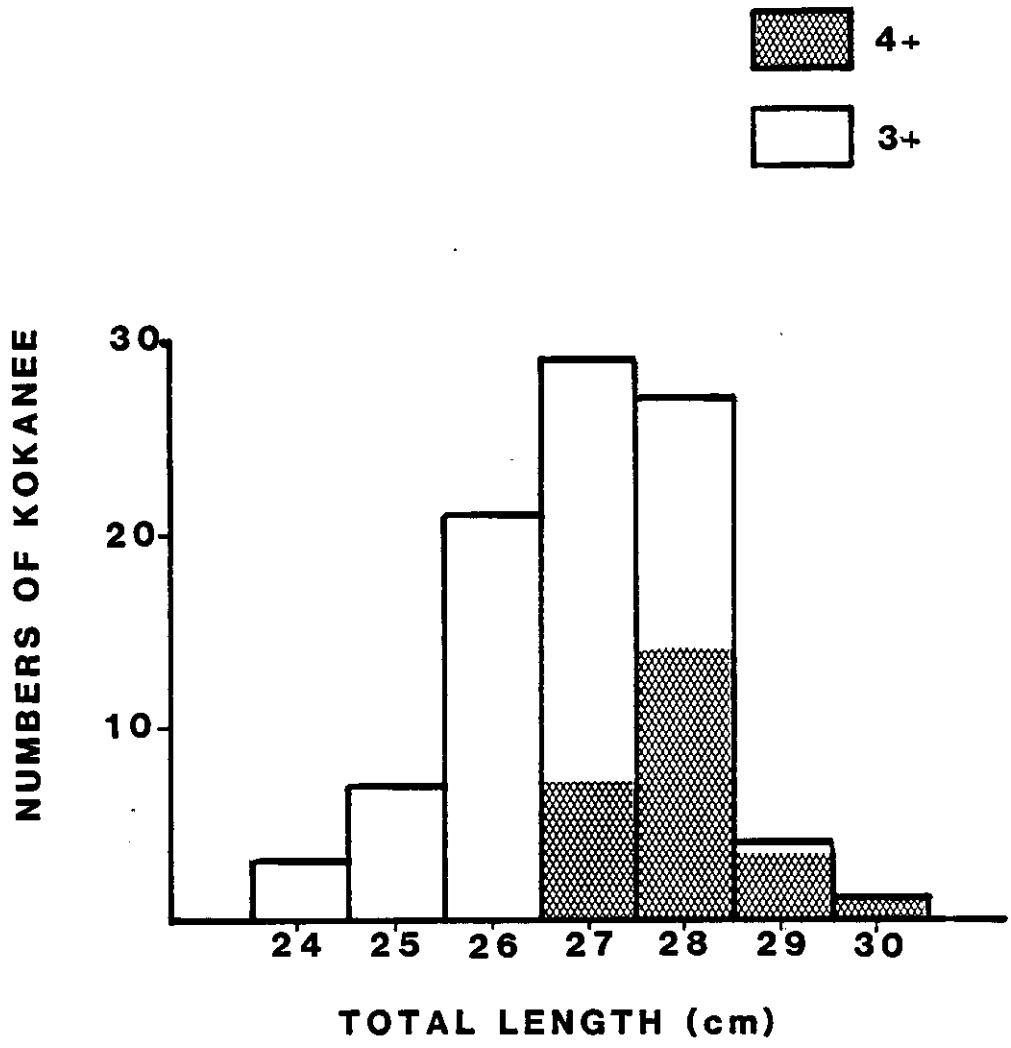

Figure 3. Age composition and length frequency of kokanee spawners collected in Spirit Lake, Idaho, 1933.

Coeur d'Alene Lake

Kokanee Population Estimates

The mid-water trawl estimate for Coeur d'Alene Lake measured 6.48 million kokanee (671/ha) in August. This compares with an estimate of 9.40 million In 1982. Individual year class strengths include 1.51 million of the 1982 cohort, 1.91 million of the 1981 cohort, 2.25 million of the 1980 cohort and 0.81 million of the 1979 cohort. Comparative year class strengths are listed in Table 7.

Potential Egg Deposition and Fry Survival

Based on trawl-captured kokanee, we estimated the potential spawning escapement of 732,700 fish. Assuming the angler harvest was negligible between trawling and spawning, a 1:1.5 male-female ratio and a fecundity of 335 eggs per female, the total potential egg deposition is estimated at 147, 273,000 eggs for 1983.

The estimated deposition in 1982 was 120,000,000 eggs, which resulted in 1,513,200 fall fry in 1983. Wild survival was estimated at 1.3% for the 1982 year class. Comparative values of fall fry survival for the period 1979-83 are given in Table 8.

Age and Length at Maturity

We examined otolilths from 152 kokanee spawners from Wolf Lodge Bay during the 1983 spawning season and found 3+ kokanee comprised 64% of the sample, 2+ comprised 34% of the sample and 4+ spawners, 2% of the sample (Fig. **4).**

We have measured kokanee spawner lengths in Coeur d'Alene Lake since 1954, and mean lengths have varied from 395 mm in 1954 to an all-time low of 212 mm in 1983 (Fig. 5).

DISCUSSION Pend Oreille lake

The ability to discern hatchery versus wild contributions to the kokanee population in Pend Oreille Lake will be increasingly difficult in future years because the 1980 year class (planted in 1981) Is the last group of hatchery-reared kokanee that was entirely tetracycline marked. Variations in detecting the survival of wild and hatchery fry are attributed to the inability to distinquish between the groups.

Table 6. Estimates of potential egg deposition, fall abundance of wild kokanee fry and subsequent kokanee survival rates In Spirit Lake, Idaho, 1981-83.

Year	Female spawning escapement estimate	Potential egg deposition	Estimate of fall fry from previous year's escapement	Wild survival rate
1981	44,650	30,540,000	--	--
1982	26,400	15,400,000	526,000	1.7%
1983	33,490	18,252,400	143,300	0.9%

Table 7. Mid-water trawl estimates of the 1975-82 year-classes made in Coeur d'Alene Lake, Idaho, during 1979-83. Estimates are in millions of kokanee.

Kokanee year-class	Year estimated				
	1983	1982	1981	1980	1979
1982	1.51				
1981	1.91	4.53			
1980	2.25	2.36	2.43		
1979	0.81	1.38	1.75	1.86	
1978		0.93	1.71	1.68	1.50
1977			1.06	1.95	2.29
1976				1.06	1.79
1975					0.45
Totals	6.48	9.20	6.95	6.55	6.03

Table 8. Estimates of potential egg deposition, fall abundance of wild kokanee fry and subsequent wild survival rates in Coeur d'Alene Lake, Idaho, in 1979-83.

Year	Female spawning escapement estimate	Potential egg deposition	Estimate of fall fry from previous year's escapement	Wild survival rate
1979	256,716	86,000,000	--	--
1980	501,492	168,000,000	1,860,000	2.2%
1981	550,000	184,000,000	2,430,000	1.4%
1982	358,200	120,000,000	4,535,000	2.5%
1983	439,620	147,273,000	1,513,200	1.3%

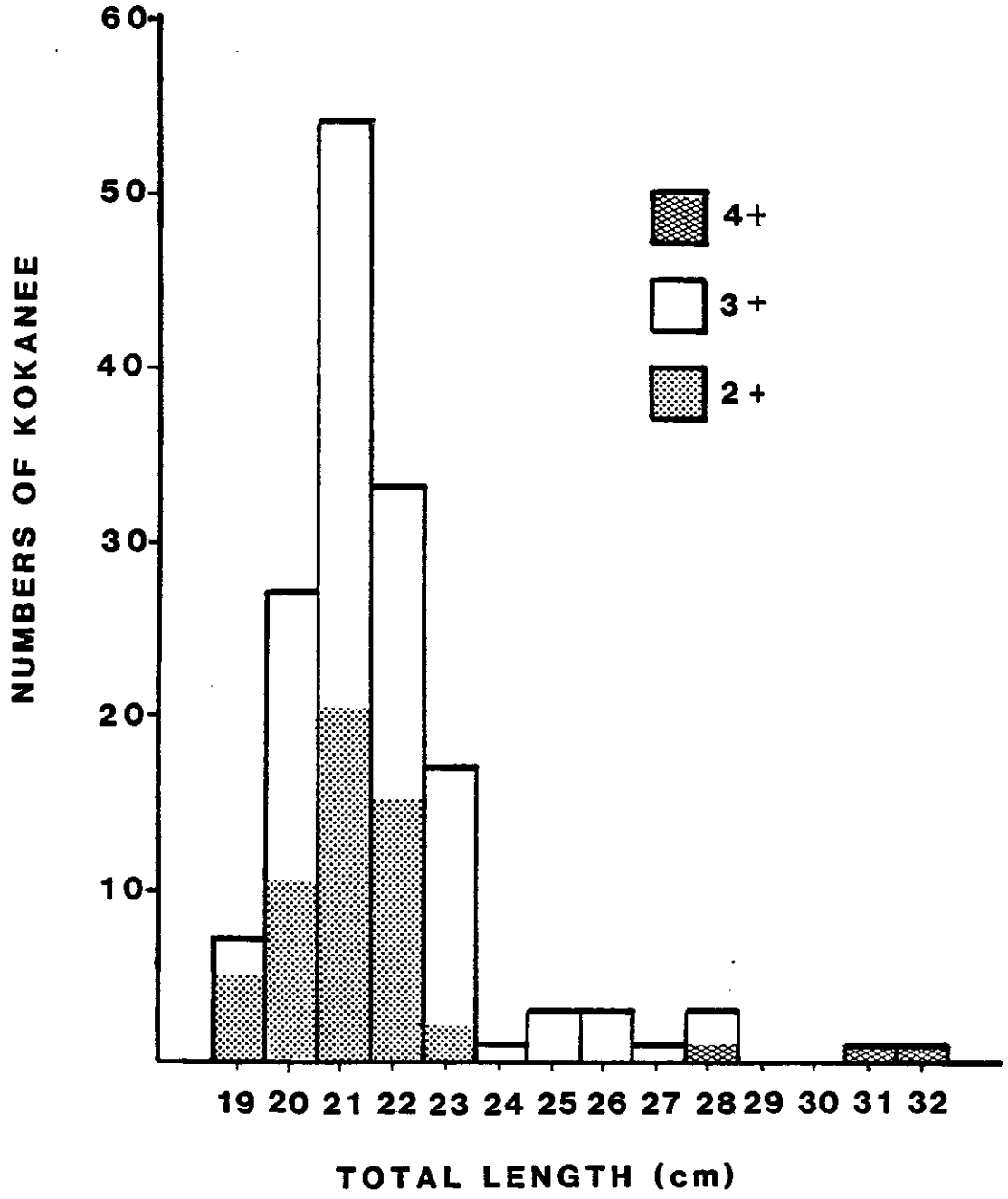

Figure 4. Age composition and length frequency of kokanee spawners collected in Coeur d'Alene Lake, Idaho, 1983.

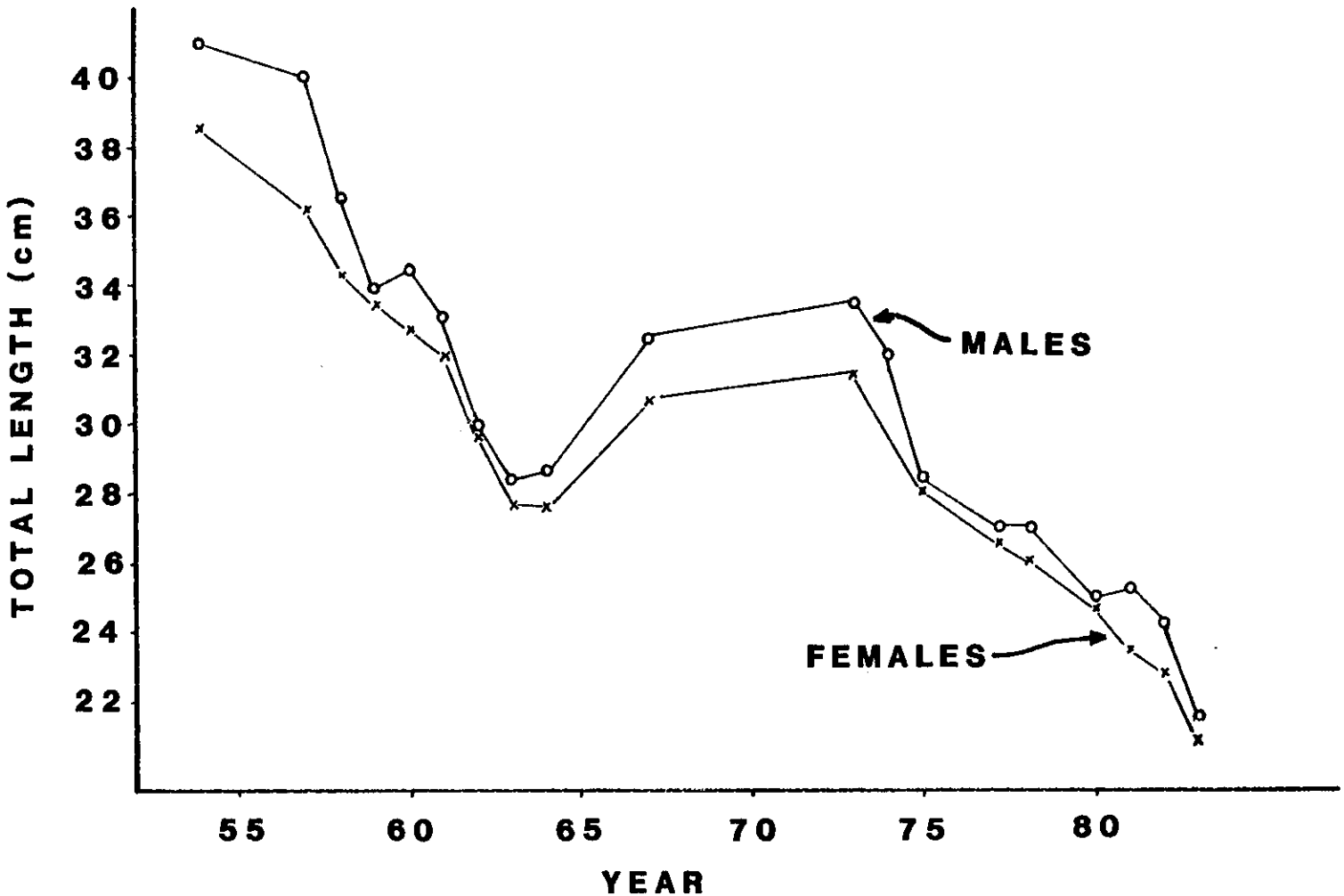

Figure 5. Mean total length of kokanee spawners collected in Coeur d'Alene Lake, Idaho, 1954-83.

Estimated survival rates of hatchery-reared fry from release time to fall sampling have not been consistent between the two years for which data are available. The low value estimated in 1983 (3.2%) may be a result of inadequate sampling of those lake sections in which approximately 25% of sampled fry were found in previous years.

Survival of marked fry released in the Clark Fork River near Cabinet Gorge Dam could be influenced by the magnitude of flow releases from the dam during the time when releases were made. Although no direct relationship can be established between flows and survival with only two years of data, there does appear to be a correlation with the highest survival rate of 32.8% in 1982 and the relatively high discharges from the dam (Table 9). Although this relationship is at best sketchy at this time, future monitoring of fry survival in relation to flows is warranted.

Estimation of survival of wild fry is not possible with the large numbers of unmarked hatchery fry being released at various locations throughout the lake. Our best estimate of this survival rate is the average of 1.18% for the period 1978-81 (Cochnauer 1983).

The wild component of the population is probably still declining as evidenced by the small number of wild mature kokanee captured in the trawl, and there is no indication that this trend will be reversed.

Again, the anticipated numbers of kokanee spawners projected to return to Granite Creek failed to materialize. Sampling throughout the lake revealed Granite Creek destined fish were spawning with all other sampled groups of kokanee, both in stream and shore spawning. The relatively small number of kokanee returning to Granite Creek this year is a result of the reduced number (1.08 million) of hatchery fry released in 1980.

The estimated kokanee population in Pend Oreille Lake was approximately 65% of that estimated in 1982. Contributing factors for this reduction are incomplete trawl sampling (only 24 of the scheduled 30 transects were sampled due to inclement weather and mechanical problems), reduction in the number of hatchery fry released and an earlier time of sampling. Bowler (1976) found that early sampling results in smaller estimated numbers of fish.

Priest lake

Survival rate of hatchery-reared fry was higher than that reported for the 1982 plant (Cochnauer 1983). An explanation would be the inadequate sampling of the lake in 1982 when only 7 transects of 14 possible were sampled. Most of the fry collected in 1983 were taken from the southernmost transects; those not sampled in 1982.

Table 9. Survival rate of hatchery-reared kokanee fry released In Clark Fork River in relationship to flow discharges from Cabinet Gorge Dam.

Dates of kokanee releases	24 hour average discharge (cfs)	Survival rate from time of release to fall sampling
1982		
July 12	36,795	
July 13	36,795	32.8%
1983		
July 28	24,250	
August 1	21,570	3.2%
August 2	13,270	
August 3	15,140	

Rates of survival between groups of planted fry are quite different. Those fish planted in Granite Creek had a survival rate five times that of fish planted in mid-lake. Reasons for this difference are unknown and comparative tests should continue with future plants.

Spirit lake

Densities of kokanee in Spirit Lake are lower than those estimated in 1982. As with Pend Oreille Lake, trawling was conducted 2-3 weeks earlier than usual and is probably the contributing factor in lower estimates.

Two relatively large year classes (1979 and 1980) will reach lengths that are catchable by fishermen in 1984 and should improve fishing on the lake.

Coeur d'Alene lake

Kokanee densities in Coeur d'Alene Lake are not as great as estimated in 1982 for the same reasons discussed above for Spirit and Pend Oreille lakes. The size of Coeur d'Alene Lake kokanee spawners continues to decrease and the younger (2+) spawners are comprising more of the spawning population.

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